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Recovery of Aboveground Biomass in Ohio, 1978

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Abstract

Timber-use studies in Ohio show that multiproduct harvesting could be improved. The recovery rate from these operations, expressed as a ratio of the merchantable stem biomass estimate, is 103 percent. Although current methods of multiproduct harvesting have improved recovery of the merchantable stem, an estimated 1,539 thousand fresh tons of total residual biomass were left unused in 1978. Modifications of present multiproduct harvesting systems could increase the recovery of aboveground biomass.
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Introduction

> Men only debate and question of the branch, not of the tree
>
> Montaigne (1580)
> Essays II, xii

The literal meaning of these words are more significant to foresters and timber processors today than Montaigne could have anticipated when he wrote them four centuries ago. Unused wood fiber in tops and branches results from the removal of sawlogs, pulpwood, and other industrial timber products. The disposition of this residue was not a problem, nor necessarily desirable.

In the past, forestry laws were restrictive, and only selected individuals were permitted to harvest trees. This resulted in the quick removal of tops and branches after timber was harvested, because fuelwood was an essential element of everyday life. But, when the use of fossil fuels increased, these tops and branches became an unwanted byproduct of harvesting.

Recently residual biomass, or the unused portions of harvested trees, has begun to take on more importance because wood for fuel is being viewed as a valuable commodity. The rising cost of energy has brought about a need to reevaluate the role that the residual biomass will play in meeting demands placed upon our renewable resources.

The Resources Evaluation unit of the USDA Forest Service has inventoried the forest resources of Ohio three times. As part of the last reinventory in 1978, field measurements were obtained from almost 900 trees that were harvested on 23 operations throughout the State. From these measurements, I developed relationships between the inventory and the amount of products that were actually removed.

The inventory biomass includes an estimate of the usable timber in the merchantable stem and an estimate of the total biomass above the stump level, excluding the foliage. The biomass in the merchantable stem between a 1-foot stump height and a minimum top diameter of 4 inches is, by Forest Service definition, the growing-stock biomass. It should agree with the amount recovered for industrial products, though this does not always happen.

The timber harvester's judgment of the usable timber contained in a tree may differ from the inventory estimate. He may see no value in a portion of the merchantable stem, and at the same time use part of the tree, or trees, considered to be unmerchantable. So, the timber harvester determines biomass removals.

Much of the woody biomass left on-site can be recovered for a number of timber products. This biomass, once considered unusable, can be converted into fuel, pulp, or small dimension stock through either secondary logging or harvesting of more than one product. Although firewood recovery is profitable, the high cost of extracting unused woody biomass by relogging an area for most other timber products is a major barrier today. Higher end-product values in the future may offset these high costs of extraction. The immediate alternative is multiproduct harvesting of the aboveground biomass to recover residual biomass.

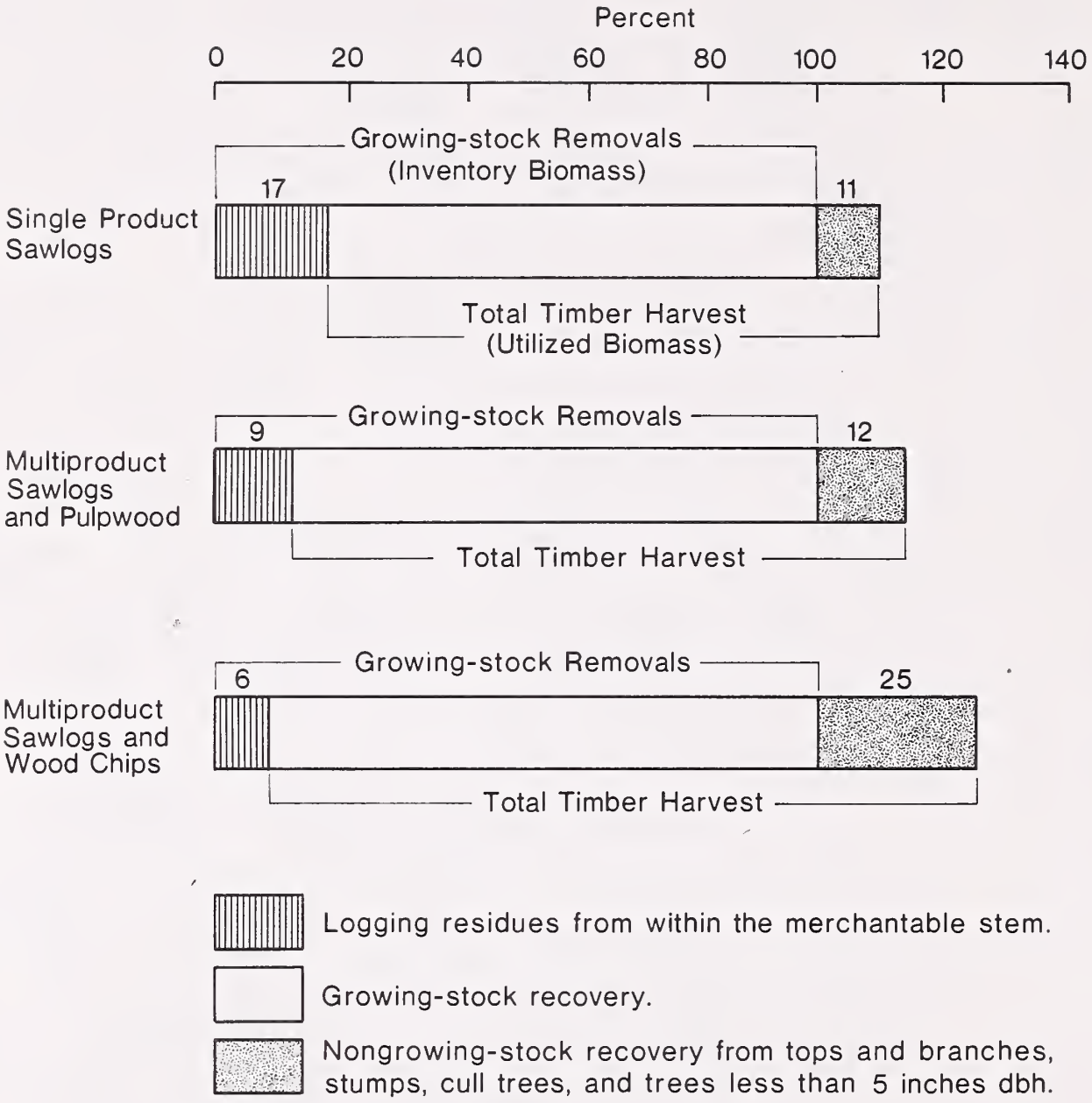

Figure 1.—Relationship of inventory to utilized hardwood biomass for three product alternatives in Ohio, 1978.

Multiproduct Recovery

The residual biomass can be an energy supplement, if it can be recovered at a profit. Multiproduct harvesting can physically recover more of the available wood supply, but because of economic restrictions, most of the timber cut from Ohio timberlands is still from operations that harvest only sawlogs.

The removal of trees for a single high-quality product usually leaves most of the nongrowing stock material above a 4-inch top, trees less than 5.0 inches diameter at breast height, and cull trees that are either too rotten or too poorly formed. Only 11 percent of the inventory was recovered from nongrowing stock in Ohio, though almost double that amount was lost from the growing stock (Fig. 1). Seventeen percent of the biomass estimated to be usable for industrial timber products was left when a single product such as hardwood sawlogs was removed.

The residues left unused are usually low in quality, but can still be used for certain industrial and nonindustrial products (Timson 1980). If markets exist, a number of products can be recovered from each tree. Although harvesting is predominantly for a single product, high levels of multiproduct harvesting suggest that there are sufficient local markets for more than one product.

Respondents to an ownership canvass conducted by the Resources Evaluation unit, confirmed that multiproduct harvesting is increasing. Of the commercial forestland owners that have had timber products harvested, over 37 percent indicated that two or more products were removed (Table 1). These land owners who harvest for more than one product control almost 48 percent of the commercial forest land being harvested.

When trees on commercial forest land are harvested for more than one product, rates of recovery are improved. Merchantable limits are moved higher up the stem, smaller diameter trees are accepted, and quality standards are lowered. In Ohio, a typical multiproduct operation removed sawlogs and pulpwood and improved recovery by 9 percent over single-product, sawlog harvests (Fig. 1). Even though growing-stock recovery was not complete (9 percent was left unused), the loss was offset by harvesting 12 percent of the inventory from nongrowing stock.

Although the harvest of sawlogs and pulpwood improved growing-stock recovery, most of the tops and branches remain unused. To recover all residual biomass and at the same time maintain the industrial timber supply, wood chips can be included as a second or third product. When this type of multiproduct harvesting was used in Ohio, recovery rates increased by as much as 25 percent over single product harvesting—11 percent from growing stock and 14 percent from nongrowing stock (Fig. 1).

Adding mobile whole-tree chippers to conventional multiproduct operations can increase yields as much as 63 fresh tons per acre (Martin 1977). Harvesting for maximum fiber production depends on local markets and high levels of technology. Opportunities do exist to modify present multiproduct harvesting systems that will recover the entire aboveground biomass.

Aboveground Biomass Removals

Biomass removed from Ohio timberlands is (1) roundwood that will be converted into industrial forest products, and (2) residual biomass from growing-stock and nongrowing-stock sources. The amount of residual biomass has been largely ignored in the past, but the volume of timber recovered for products is periodically monitored.

Industrial Timber Harvest

During 1978, an estimated 2,492 thousand tons of fresh material were removed from Ohio timberlands for primary manufacturing purposes (Table 2). Of this, almost 70 percent went to sawmills or to

Table 1.—Number of owners and corresponding areas of commercial forest land by number of products[a] harvested in Ohio, 1978

Number of products harvested	Number of owners	Percent	Acres of commercial forest land owned	Percent
One product	74,200	63	1,582,800	52
Two products	38,000	32	942,100	31
Three products	5,700	5	371,000	12
Four or more products	400	b	130,700	5
Total harvested	118,300	100	3,026,600	100

[a] Includes industrial and nonindustrial timber products.
[b] Less than 0.5 percent.

Table 2.—Aboveground biomass removals, by product and species harvested in Ohio, 1978.

Product and Species group	Standard units	Timber product recovery[a] Volume in standard units	Roundwood volume	Roundwood weight	Residual biomass
			Thousand cubic feet	*Thousand fresh tons*	
Sawlogs[b]					
Softwood	M board feet[c]	5,696	877	29	18
Hardwood	M board feet[c]	330,870	48,564	1,703	1,028
All species		336,566	49,441	1,732	1,046
Pulpwood					
Softwood	Standard cords	4,422	374	12	7
Hardwood	Standard cords	247,424	21,029	649	422
All species		251,846	21,403	661	429
Other products[d]					
Softwood	M cubic feet	963	963	30	19
Hardwood	M cubic feet	2,239	2,239	69	45
All species		3,202	3,202	99	64
All Products					
Softwood			2,214	71	44
Hardwood			71,832	2,421	1,495
All species			74,046	2,492	1,539

[a] Adapted from: Nevel, Robert L., Jr.; Redett, Robert B. Ohio timber industries—a periodic assessment of timber output. 1980; USDA For. Serv. Resour. Bull. NE-64. 33 p.
[b] Includes veneer logs and cooperage logs.
[c] International 1/4-inch rule.
[d] Includes mine timbers, guard rails, handle stock, metallurgical wood, poles, posts, and piling.

manufacturers of veneer and cooperage. Most of the remaining 760 thousand fresh tons were used for pulpwood. Although much of the harvested aboveground biomass is recovered for industrial products, more than 38 percent remains unused.

Uses for the total tree have progressed, and a greater amount of the unmerchantable material (by current standards) can be used to produce pulp and board products. New and innovative uses for wood include soil amendments and mulch, bulking agents for sludge treatment, livestock bedding and feedstock, and energy production. While developments to harvest and process new products have been rapid, methods to quantify additional sources of wood fiber have not kept pace. A limitation has been the lack of information regarding the annual production of residual biomass.

Residual Biomass

From the results of the Ohio study, I developed a mathematical equation to estimate the weight of harvesting residues based on the volume of timber harvested annually:

$$R = V \times W$$

where:

R = Total residual biomass, in fresh tons.

V = Volume of roundwood timber harvested for a specific product and species class, in thousand cubic feet.

W = Ratio of topwood, branchwood, and unused merchantable stem weight to growing-stock volume, in fresh tons per thousand cubic feet of growing stock. Values used were 20.4305 for softwood sawlogs, 21.1629 for hardwood sawlogs, 19.3409 for softwood pulpwood and other products, and 20.0585 for hardwood pulpwood and other products.

Using this equation I found that a large portion of the aboveground biomass is left as a residue of the harvesting process. An estimated 1,539 thousand fresh tons of residual biomass were left unused. This represents almost 62 percent of the annual roundwood harvest (Table 2). Yet, a portion of this cannot realistically be recovered.

The economics of recovery dictate that less than total use will be achieved even with the most efficient methods of timber harvesting and processing. Even so, with the 2,492 thousand fresh tons currently being recovered for industrial timber products in Ohio, the addition of residual biomass could boost the potential product recovery to 4,031 thousand fresh tons.

Conclusions

As the demand for wood fiber grows, more of the wood and bark in tree tops and nongrowing-stock trees will be recovered and processed at a profit. Multiproduct harvesting, which has become an established practice in Ohio, is a practical opportunity to recover these residues. Merchantability limits can be redefined to include the total aboveground biomass, and it is no longer necessary to think of residues as unmerchantable material.

Most of the biomass that normally accumulates and decomposes if left unused seems to be ideally suited for wood chips and firewood. These products, already a component of some multiproduct operations, will play a larger role as the demand for fuelwood continues to skyrocket. As competition increases, foresters may continue to "debate and question of the branch,. . ."—not whether it should be recovered, but for what product shall it be used.

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